Article X.

LITHOTRITY BY A SINGLE OPERATION. By HENRY J. BIGELOW, M.D., Professor of Surgery in Harvard University, and Surgeon to the Massachusetts General Hospital.

When Sydney Smith asked, "What human plan, device, or invention two hundred and seventy years old does not require reconsideration?" he would no doubt have regarded with favour an occasional reconsideration of the theory and practice of medicine and surgery—especially in view of the current belief, that their traditions have been kept alive and their rules prescribed in part by authority. The surgical literature of lithotomy, both French and English, so long showed the influence of the early specialists, that we have hardly now escaped from its exaggerated circumstance and detail. And yet, with attention to a few precise rules, the operation of lithotomy is quite a simple one—much less difficult, for example, than the dissection of tumours. It is not impossible that convictions in some degree traditionary may prevail in regard to certain points connected with the practice of the more recent art of lithotrity.

Civiale was among the first to inculcate the excessive susceptibility of the bladder under instruments. Later surgeons, perhaps influenced in part by his teaching, have continued to invest the operation of lithotrity with precautions, which, though by no means groundless, because under certain conditions both the bladder and the urethra are actively resentful of even slight interference, are nevertheless greater than this operation generally requires. As a rule, there is little difficulty in it. The stone is readily caught and broken into fragments, of which a few are pulverized; a large-eyed catheter is then sometimes introduced; a little sand and a few fragments of stone are washed out; after which the patient is kept quiet to discharge the remainder, and await another "sitting." Under favourable circumstances, such an operation, lasting a few minutes, is not only simple, but safe. Yet the fact that it is not always so could not fail to arrest the attention of surgeons. It may happen that during the succeeding night the patient has a chill: not the chill of so-called "urethral fever," which sometimes follows the mere passage of a bougie, and which is of little consequence; but one accompanied or followed by other symptoms, such as tenderness of the region of the bladder, a quickened pulse, and the frequent and painful passage of urine. These symptoms may insidiously persist, rather than abate; others may supervene. The surgeon vainly waits for a favourable moment to repeat his operation; it becomes too evident that the patient is seriously ill, and it is quite within the range of possibilities that in the course of days or weeks he may quietly succumb. An autopsy discloses a variety of lesions; some of them remote or obscure, others of more obvious origin; and among these, not the least common, an inflamed bladder, upon the floor of which angular fragments and chips of stone are resting. It is then evident that during a certain interval before death the bladder was not in condition for further instrumental interference; and although, in view of the fatal result of delay, lithotomy or active lithotrity, to both of which in cases like this I have resorted, might have been on the whole the least of evils, it is plain that either operation would have furnished in itself an additional cause of serious inflammation.

Such a result might be supposed to point to the necessity of extreme precaution; and it will be justly urged that the purpose of such interference at an unfavourable moment is the removal of the offending fragments as a last resource. But if at the first operation the bladder could have been completely disembarrassed of every particle of stone, even with the risk of irritating its lining membrane, we can hardly doubt that the relief would then have been followed by ready repair. In short, it is difficult to avoid the conviction, that, in an average case, damage to the mucous membrane, and quite as great, is as likely to follow the persistent irritation of angular fragments as the protracted use of instruments for the entire removal of a stone, provided only this can be accomplished.

It is probable that the injury from the use of instruments has been in some measure confounded with that resulting from the presence of fragments in the bladder. That the average bladder and urethra have no extreme susceptibility is attested by the generally favourable results of lithotrity, and even of catheterism, which are practised with very varying skill everywhere; also by the singularly innocuous results of laceration of the contracted urethra, by an instrument like that of Voillemier for example; so, too, by their recovery from the considerable injury inflicted during the extraction of a large and rough stone in lithotomy. The bladder is often also tolerant to an extraordinary degree of the presence even of a mulberry calculus. When we remember that in this case it clasps the stone at every micturition, often with a persistent gripe, the comparative immunity of its tender mucous membrane is quite remarkable. But when sharp fragments are thus embraced, presenting fresh and acute angles, which do not soon become blunted, and to which the bladder is unaccustomed, it is more remarkable that serious consequences are the exception, and not the rule, in lithotrity. Polished metallic surfaces carefully manipulated can hardly do such damage as the agencies here enumerated.

Gentleness, dexterity, and experience are especially to be valued in lithotrity. It has been well said, that no novice should undertake this operation. But the habit of confounding the symptoms resulting from the presence of fragments with those following the use of instruments originally led to precautions in the introduction and manipulation of the latter which were sometimes excessive. Civiale, with an almost unparalleled experience, introduced a small lithotrite with much less pressure than its own weight, and with uniform and great slowness. And yet, in a healthy urethra, it is only at the triangular ligament and beyond it that such extreme care is called for. Civiale, who had no means of evacuating fragments in the bladder, restricted the length of his operation to two or three, or perhaps five, minutes. The same solicitude seems to have led Sir Henry Thompson, in his admirable and standard work upon this subject, to assign two minutes as the proper average duration of a sitting; a period which his exceptional skill has often in his own practice enabled him materially to reduce. I have been gratified to find, however, that since he has availed himself of the advantage of etherization he recognizes the benefit to be derived from somewhat more prolonged manipulation. My own conviction is, that it is better to protract the operation indefinitely in point of time, if thus the whole stone can be removed without serious injury to the bladder. I believe, that, in any case which is as favourable to lithotrity as the average in these days when stones are detected early, this can be effected; and that, if the bladder be completely emptied of detritus, we have as little to apprehend from the fatigue of the organ consequent upon such manipulation as from the alternative of residual fragments and further operations. The duration of the sittings in the cases reported at the end of this paper varied from three-quarters of an hour to three hours and three-quarters. The bladder can be thus completely and at once evacuated, in a majority ot cases. The stone, after crushing, can be removed through the urethra by a tube contrived for the purpose.

But has not this result already been attained by evacuating instruments variously devised and modified? The following quotations from the latest authorities sufficiently answer this question in the negative :—

> "We may here say, without fear of being accused of exaggeration, that evacuating injections practised after sittings of lithotrity have no apology for their use. *The whole surgical arsenal invented for their performance is absolutely useless. . . . . It should be well understood that the best of the evacuating catheters is worthless.*" (Article "Lithotritie," by Demarquay et Cousin, in the *Nouveau Dictionnaire de Médecine et de Chirurgie Pratique*, Paris, 1875, pp. 693–4.)
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> "*The practice of injecting the bladder to wash out detritus is obsolete. . . . . The apparatus of Mr. Clover should not be employed, if it be possible to dispense with it;* as its use is quite as irritating as lithotrity itself." (S. D. Gross, *Diseases, etc., of the Urinary Organs*, Philadelphia, 1876, p. 232.)
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> "Having used it very frequently" (Clover's Apparatus), "I would add that it is necessary to use all such apparatus with extreme gentleness, and *I prefer to do without it*, if possible." (Sir H. Thompson, *Practical Lithotrity and Lithotomy.* 1871, p. 215.)
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> "*All these evacuating catheters are little employed.* They require frequent and long manœuvres which are not exempt from dangers; besides, *they give passage, as a rule, only to dust, or to little fragments of stone, which would have escaped of themselves without inconvenience to the urethra.*" (Article, "Lithotritie," by M. Voillemier, *Dictionnaire Encyclopédique des Sciences Méd.* 1869, p. 733.)

In short, the "evacuating apparatus" hitherto employed does not evacuate.

It is not a recent contrivance. From the earlier days of lithrotrity, the operation of breaking the stone has been followed by the obvious expedient of introducing a large and special catheter, through which water was injected and allowed to escape, bringing away a little sand with a small fragment or two. This attempt at evacuation was aided by suction. With this object, and before the year 1846, Sir Philip Crampton employed an exhausted glass globe. For the same purpose a syringe has been used, or a rubber enema or hydrocele bottle, with which fluid could be also injected and the bladder washed. By entering the catheter well within the bottle or syringe, fragments were dropped inside the neck, where lying below the current, they were not returned to the bladder when the bottle was again compressed. When this neck was made of glass by Clover, the fragments became visible; and to this neat arrangement the accomplished lithotritist, Sir Henry Thompson, refers, as Clover's bottle. But neither the previous practice nor the efficiency of evacuation by suction through a tube had been materially advanced. In the mean time the syringe was modified in France by a rack and pinion attached to the piston, so that water could be injected and withdrawn with great force; a procedure not only useless, but detrimental to the bladder, if it be inflamed and thickened.

Before describing my own instruments, it may be well to say a word in regard to the introduction of instruments, especially large ones, into the bladder; an important subject in this connection.

A syringe facilitates an abundant use of oil whether in the urethra or within a tube. Into the normal urethra a straight instrument can be introduced with at least as much accuracy as a curved one. Either may be passed rapidly as far as the triangular ligament—unless the instrument is very large, in which case great care is required not to rupture the mucous membrane. Having reached this point, which requires that the instrument should be passed as far as it will go in the general direction of the anus, the extremity of the instrument depresses the floor of the urethra in front of the ligament. Traction upon the penis next effaces this depression, and adds firmness to the urethral walls; so that if the instrument be withdrawn a little, and, at the same time, guided by the bony arch above, it can be coaxed without difficulty through the ligament in question—a natural obstruction which physicians often mistake for a stricture. This obstruction passed, the rest of the canal is short, and corresponds to the axis of the body. Even the enlarged prostate can often be traversed advantageously by a straight instrument. In fact, a prostatic catheter, as is well known, consists mainly of an inch or two of straighter tube added to the extremity of a common catheter, to reach through the unyielding prostate before the hand is depressed and the beak turned up. In passing either a sound, catheter, or lithotrite, the extremity of a straight instrument, and, which would be less expected, the convexity of a curved one, may be arrested just at the entrance of the bladder by the firm lower edge of the inner meatus. The fact that water now passes through the inner meatus thus dilated, or that a stone is felt with the tip of the curved instrument which has really entered the bladder, may lead the operator into the mistake of supposing that the instrument is fairly in it; and I have known its further entrance, after sliding over this obstacle, to be erroneously attributed to the existence of a second, or hourglass cavity, in the bladder itself. To obviate this difficulty, and so soon as the triangular ligament is passed, the catheter should be pressed through the indurated neck, or prostate, in the direction of the axis of the body, with the hand on the perineum; a most efficient manœuvre, when the prostate is large. If there be doubt, the tip should of course be sought and guided in the rectum. After introduction, a straight tube, or the shaft of a curved one, returns to an angle of about 45° with the recumbent body, and, if the patient is not etherized, a feeling of tension may then be relieved by depressing, with the hand upon the pubes, the suspensory ligament of the penis; an expedient also useful during the passage of the instrument.

My own practice has always been to etherize for lithotrity.

Each operator prefers the position to which he is accustomed; and when the urethra is healthy, this is of very little importance. But if there be stricture or prostatic obstruction, a position at the patient's left side enables the operator to hold and direct the instrument to advantage with the right hand, leaving the left hand free to act in the perinæum. After the instrument is introduced, and both hands are required above the pubes, they are most available, if the surgeon changes his position and stands upon the patient's right.

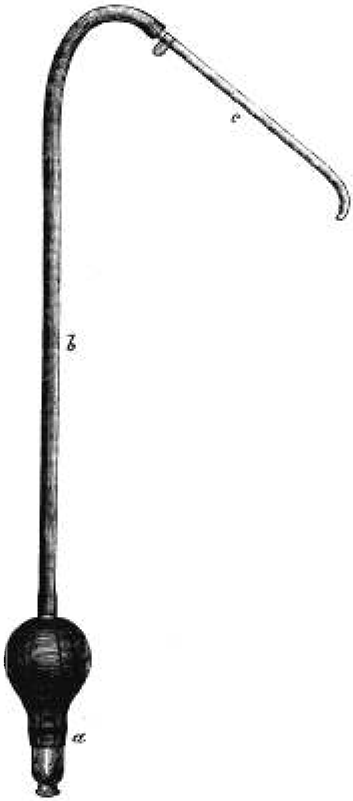
It is well, by a preliminary injection, to ascertain carefully the capacity of the bladder by emptying it and then refilling it slowly with warm water, previously measured, until the water is expelled through the loosely held urethra, by the side of the tube. In the etherized subject a short pipe or nozzle suffices for this purpose. I have for many years employed a common Davidson's syringe. An unetherized patient may for a moment resist this injection through a short tube, by contracting the sphincter of the bladder; but this readily yields. Except in a large bladder, a capacity of eight or ten ounces need not be increased. The smaller the injection, the more readily, indeed, do fragments fall into the blades of the instrument. But, unfortunately, so also does the mucous membrane. In fact, with too little fluid in the bladder, the use of a lithotrite in unpractised hands is attended with danger; and in a long sitting, an injection which will render the walls moderately tense is the only really safe way of keeping the bladder from between the blades. After careful examination of the action of a lithotrite through an opening in the summit of the bladder, I have returned to this opinion, which was held by the older writers on this subject. From time to time the diameter of the collapsing bladder should be estimated by carefully opening the blades of the lithotrite, and water should be introduced when necessary; but care should be taken not to injure a contracted bladder by first distending it, and afterwards adding to it the contents of the aspirating bottle.

A tape or an elastic band wound lightly once or twice around the penis retards the escape of injected water, and yet allows the movements of the tube or lithotrite.

In order to ascertain the maximum calibre of the urethra, before introducing a tube, it should be measured by an instrument which will enter more readily than the tube. Such instruments we have in Van Buren's sounds, which are slightly curved at the end, and a little conical. Being made of solid metal, and nickel-plated, they traverse the urethra with singular facility. Otis's sounds also answer admirably for this purpose.

EVACUATING INSTRUMENT. (Fig. 1.)—The following points are worthy of consideration in connection with any evacuating apparatus. The ten-ounce elastic bulb or bottle usually supplied with such an instrument is inadequate to the exhaustion for which it is designed. It will barely sustain, without collapse, a vertical column of water of the length of a catheter. A thicker flask fatigues the hand of the operator. The bulb is also an awkward weight at the top of the catheter. These difficulties are obviated by interposing between the catheter and bulb two feet of rubber tube, which relieves the bladder from the force of any movement of the apparatus, and, what is more important, allows the operator to hold the bulb on a level with the water in the bladder, or considerably below it. The exhaust then acts as a siphon, and readily draws off the water. The fragments gravitate to the bottom of the bulb, and may there be collected in a glass chamber. (See Fig. 1, *a*.) To prevent the possible return to the bladder of some single fragment while on its way to this receptacle, the rubber tube might be provided with a small glass trap containing a wire-gauze or perforated tube, or valve, to deliver the current and strain it on its return.

Fig. 1.



Evacuating Apparatus. *a.* Elastic bulb and glass receptacle with brass cap, for debris. *b.* Rubber tube two feet in length. *c.* Evacuating tube of silver.

The successful evacuation of the bladder depends upon several conditions, both in the apparatus and its use, which, for distinctness, may be enumerated separately.

1. *A large calibre of the evacuating tube.*
2. *Its shape.*
3. *The shape of its receiving extremity.*
4. *The assemblage of fragments around this extremity.*
5. *The immediate recognition and removal of any obstruction in the tube.*

1. *A large calibre of the evacuating tube.*—Whether or not we adopt the view of Otis, that the average capacity of the normal urethra is about 33 of Charrière, there can be no question that it will admit a much larger tube than that commonly attached to either Clover's or the French apparatus. The efficiency of the process of evacuation depends much upon using the largest tube the urethra will admit. This fact has been stated by Sir Henry Thompson. But he recommends for the glass cylinder or trap which is to admit this tube a "perforation at the end, the size of a No. 14 catheter," = 25 Charrière. (*Diseases of the Prostate*, 4th edition, 1873, p. 337.) This perforation is too small; and the tube which is designed to enter it is further reduced by its collar to the diameter of only 12, = 21 Charrière. In fact, this is the calibre of the evacuating catheters now attached to Clover's instrument, and is of itself fatal to their efficiency. An effective tube has a calibre of 28 to 31 or even 32 Charrière, and the meatus, which is the narrowest part, may, if necessary, be slit to admit it, if the urethra is otherwise capacious. Again, in the instrument, as sometimes constructed by Weiss, a joint is made by inserting an upper tube into a lower one, thus obstructing the calibre by a shoulder. The joints should become larger as the tube approaches the bottle, and the tube then delivers without difficulty fragments of its own calibre.

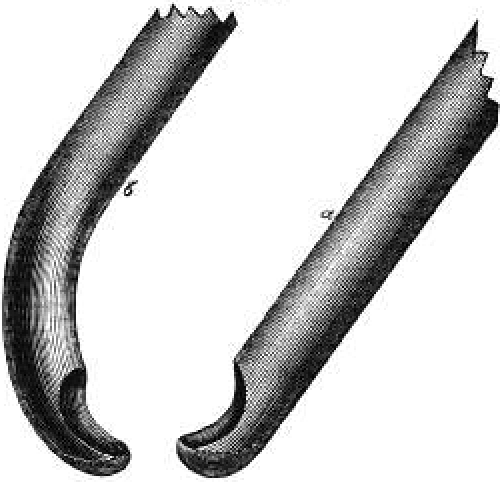
My tubes are of thin silver, of sizes 27, 28, 29, 30, and 31, *filière* Charrière, respectively.

2. *Shape of the tube.*—Works upon Lithotrity enumerate and figure a variety of tubes through which fragments are to be aspirated. Many of these are useless. The best tube is either straight, or curved quite near the extremity; the latter to be used with the curve inverted and directed downward, the orifice then looking forward. (Fig. 2.)

3. *Shape of the receiving extremity.*—The receiving extremity should depress the bladder, and thus invite the fragments, while its orifice remains unobstructed by the mucous membrane. A fragment of stone, however light, if it lies at the distance of a half or even a quarter of an inch from the tube extremity, is not attracted by the usual exhaust of the expanding bottle, which requires that the fragment should lie almost in contact with the tube. A very slight obstacle impedes its entrance; and this fact renders inefficient all tubes like catheters, with orifices in the side or upper wall. Chips will not surmount their edge. Again, the orifice of a tube cut square is at once occluded by drawing in the vesical wall; while the spoon-shaped beak of the French instrument, made like the female blade

of a lithotrite, allows fragments to lie too far from the opening in the tube. The best orifice is at the side of the extremity, and is made by bending the tube at a sharp right angle, carefully rounding the elbow, and then cutting off the bent branch close to the straight tube. (Fig. 2 *a.*) The tube is then practically straight; while its orifice, which is slightly oval, delivers a stream at an angle with it. The edge should be thickened and rounded so as to slide smoothly through the urethra, any rim inside the orifice should be masked by a false floor, but the calibre should be nowhere contracted. If the side walls of this orifice be removed a little, it gives an unguiform extremity to the tube, which is advantageous; and in introducing such a straight tube, this tip may be gently insinuated through the triangular ligament by rotation. If a couple of inches of the end of such a tube be bent, it may be inverted after introduction, and will bury itself in the floor of the bladder, which it depresses, while the orifice looks forward and is unobstructed. This form is quite efficient. (Fig. 2 *b.*) An effective instrument might also be made of a tube cut square at the end, if a disk convex outwardly, to repel the bladder, were attached to it, at the distance of a diameter, by a bit of stiff metal. When such an instrument is introduced, the interval may be filled by a rod. In fact, the orifice of the tube should be contrived with a view to its introduction. The French tube already spoken of, shaped like the female blade of a lithotrite, would be efficient, if it were made large enough—and provided also it were kept standing upon its heel in the bladder, with a shoe bent to make a precipitously inclined plane for the fragments. It would then offer a prolongation of the unguiform tip. But thus sharply bent, it would be

Fig. 2.



Evacuating Tubes, with unguiform extremity. *a.* Straight tube. *b.* Curved tube. The dotted lines show the inside floor. The tubes are here of a diameter 31 Charrière.

less easy to introduce. Whatever be added to the extremity of the tube, in order to facilitate its introduction or to repel the bladder, should not prevent the orifice from lying in the floor of the bladder at the apex of a steep inverted tunnel.

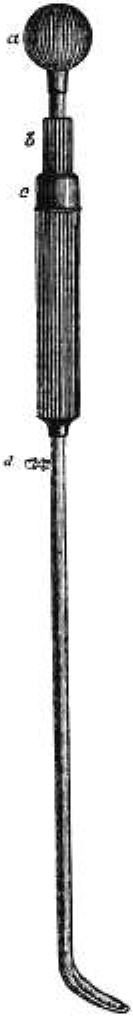
4. *The assemblage of fragments around the extremity.*—If the orifice of the tube be now placed among the fragments, it will be found that even a teaspoonful of water, lightly injected, shoots them to every part of the bladder, whence suction wholly fails to attract them, unless by chance. But if the compressed bottle be held motionless four or five seconds, the fragments gravitate to the lowest part of the bladder at the point where the extremity of the tube indents it. This artificial depression, which is made by very slight force, plays an important part both in crushing and evacuating the fragments. In placing the tube in a bed of fragments before each aspiration, there is opportunity for a little tact, as in discovering fragments with a lithotrite. The readiness with which fragments are thrown to a distance by an almost imperceptible compression of the bottle, the time required for their gravitation, and the difficulty of attracting them even at the distance of only a quarter of an inch, will hardly be appreciated without experiments outside the bladder.

5. *The immediate recognition and removal of obstruction in the tube.*—There is but one usual source of obstruction to the exhaust, namely, too large a fragment at the orifice; and then even the powerful rack and pinion of the French syringe are of no avail. The obvious remedy is to expel the fragment by compression in the ordinary way. It is therefore essential to recognize its presence at once. Practically, during the whole process, I watch the expanding bottle while the dimple in its side is gradually effaced. If this dimple remains stationary for a moment, I know that a fragment obstructs the orifice, expel it without loss of time, allow the fragments to settle, and take my chance for another. With the lateral orifice described, and enough water to separate the walls of the bladder, there is little probability of obstruction by drawing in the mucous membrane, so long as the orifice looks upward; but if the orifice of the straight tube be rotated sideways, or to face the spine, the bladder at once plugs it. With the inverted curved tube, the bladder is less readily engaged.

After a dozen or two aspirations it may be found that all the fragments which can pass the tube have done so. By the usual method of crushing, the lithotrite would now again be introduced, and again be followed by the tube.

Lithotrite (Fig. 3.)—It would be plainly desirable, if it were easy, to crush the whole stone at once, before attempting to evacuate it; but this has hitherto been rarely possible. The lithotrite becomes so choked with impacted debris that the convex surface of the mass less readily receives additional fragments. A clean lithotrite always works to best advantage; and the operator frequently withdraws the loaded instrument, sometimes with injury to the neck of the bladder, to evacuate it. It would be obviously better, if the instrument could be emptied at will in the bladder —especially if we distinctly recognize that what can be withdrawn in a lithotrite would come better through a tube, and that the only province of the lithotrite should be to pulverize, or indeed merely to comminute, and not to evacuate.

Fig. 3.



Lithotrite by Collin & Cie., from a working model. *a*. Ball which turns the screw. *b*. Revolving cylinder-handle attached to the screw-guard, which also revolves. This guard consists of two square or T-shaped rods. They slide through notches in the cap of the lock. By their revolution the cylinder-handle turns the cap and operates upon the lock. *c*. Cap of the lock, which by its revolution wedges up the screws. *d*. Injecting pipe communicating with the blades.

Although all lithotrites are made a little loose for the purpose of working out the debris, and although I have had one constructed with an especial device for this motion, I do not find it easy to clear the concave blade by lateral movement of the male blade, chiefly because the impaction is so firm, that the dense mass, instead of yielding, twists the female blade from side to side. Nor does an instrument like that of Reliquet fulfil the indications. It discharges itself, indeed, as does the old fenestrated "lithoclast." But, as in all lithoclasts, its high sides are an obstacle to the approach of fragments. The male blade also of Reliquet's instrument is that of the lithoclast; and we need only close the blades between the thumb and finger to be satisfied of their scissor-like action upon the bladder.

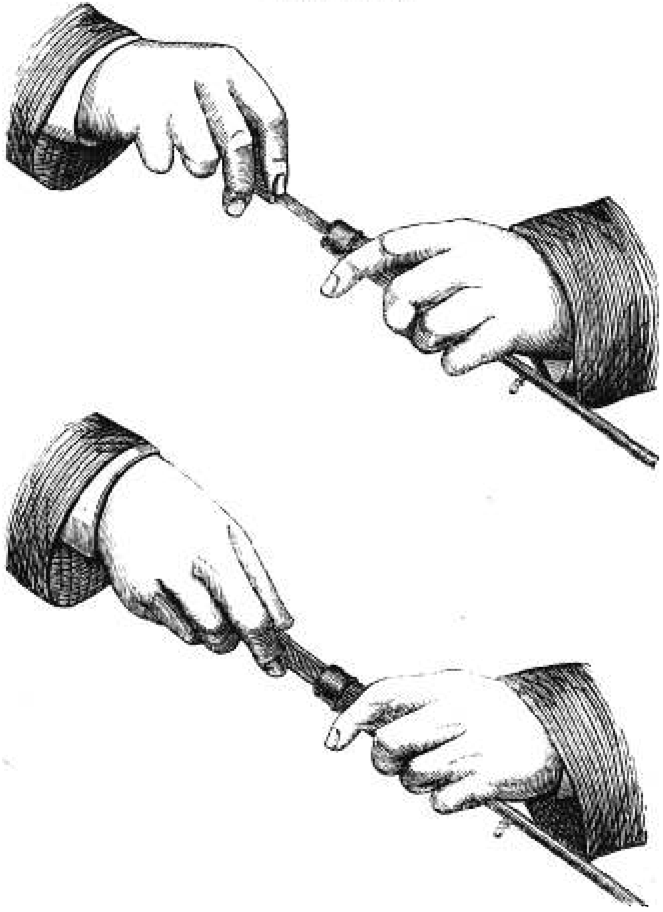
The instrument about to be described keeps its blades clear, and secures certain other desirable ends relating to the injection of water, the lock, handle, etc.

Lock. The general acceptance of the cylindrical handle of Thompson's instrument testifies to its convenience as a hold for the left hand. But it is always a little awkward to disengage the thumb of this hand, or in fact of either hand, in order to close the lock of a lithotrite at the critical moment of grasping the stone. This objection I have obviated, in closing the lock by rotation of the right wrist without displacement of the fingers. (Figs. 4 and 5.)

Wheel. In a protracted sitting, the wheel is an inconvenient handle; its chief merit being that it affords so insecure a grasp, that the operator is supposed to be unable, with its prescribed radius, to break the blades. But in a larger instrument these blades are stronger, and a ball may be substituted for the wheel.

Injecting tube. If the sitting be protracted, as proposed, the water dribbles away; and the collapsing bladder, especially if trabeculated, is liable to serious damage from the lithotrite. To meet this difficulty, my lithotrite contains a tube or groove between the blades, for the injection of water without removal. (Fig. 3 *d.*) I formerly injected water by means of a short flat tube inserted into the urethra from time to time, by the side of the lithotrite.

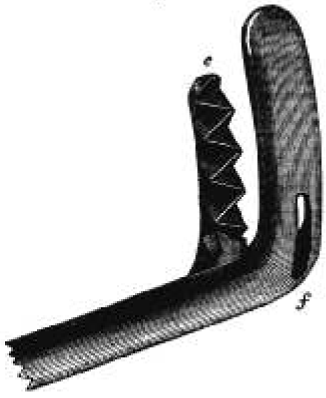
Figs. 4 and 5.



Position of the hands in holding and locking the Lithotrite. Fig. 4. Lithotrite unlocked. Fig. 5. Lithotrite locked by a quarter rotation of the right wrist.

Blades. The blades of this lithotrite consist of a shoe, or female blade, the sides of which are so low that a fragment readily falls upon it; while the male blade, or stamp, offers a series of alternate triangular notches by whose inclined planes the detritus escapes laterally after being crushed against the floor and rim of the shoe. At the heel of the shoe, where most of the stone is usually comminuted, and where the impact is therefore greatest, the floor is high and discharges itself laterally, while its customary slot (Fig. 6 *f*) is made to work effectively. It may be unnecessary to say that the female blade of the common lithotrite, when drawn from a flat plate, as in the French instrument, has a disadvantageous cavity at the heel, where the greatest impaction occurs by gravitation.

Fig. 6.



e. Male blade, presenting, on alternate sides, triangular notches. The small portion of debris not discharged laterally by these notches is driven through the slot in the female blade. *f.* Slot in the female blade.

One of the dangers of lithotrity, which has been already emphasized, is the liability of the bladder to be nipped in the instrument. In view of the character of many of the instruments sold, we might expect to hear more of this accident, although indeed it is a quiet one. It cannot be too carefully provided against, not only by skill in the operator, but also in the construction of the instrument; especially during a protracted operation, while water is escaping and the bladder collapsing. With this object, the shoe is here wider and longer than is usual, to repel the vesical walls. (Fig. 6 *f*.)

It can hardly be doubted, that, in practice, dexterous operators secure most stones and fragments as they gravitate into the female blade while it depresses the floor of the bladder, perhaps a little to one side or the other, where the stone is felt. A similar and efficient manœuvre, especially for a small fragment, is that of opening the blades of the lithotrite widely in the vertical position, then slowly turning them to one side and closing them along the floor of the bladder. If, in attempting this, the instrument be opened after it is turned, the male blade displaces the fragment without securing it; and it is of course understood, that, in opening the lithotrite, the blade in contact with the bladder, commonly the female blade, is stationary. The inverted lithotrite works efficiently in a depression, if the bladder be kept out of harm's way by a special device; but with the common lithotrite it is important to turn the blades up before crushing, and move them, in order to be sure they are free. In the exceptional case of a stone behind the prostate, it may be necessary to invert the lithotrite and seek it. Fragments, however, are readily washed from this region within reach of the evacuating tube, by occasionally turning the orifice and directing the stream from the tube upon them.

While many years ago I had not unfrequently prolonged lithotrity to ten or fifteen minutes, and longer, it is only within two years that I have aimed at the evacuation of a considerable stone during a single sitting; and although long experience will perhaps be necessary to determine precisely what cases are unfavourable to such an operation, there can now be no question that it is practicable to remove at once a far greater quantity of débris than has hitherto been considered possible. The conditions least favourable to lithotrity are obviously least favourable to this modification of it—a stone neither very large nor hard, and especially a large urethra, promising its best results. But if the preceding views are correct, the future of lithotrity lies in the direction of a fast-working lithotrite, which, while it effectually protects the bladder, is more powerful than the usual instrument, and better proportioned to the work it is to do—a rapid comminution of the stone—its immediate and complete evacuation by means of a large tube with an efficient orifice, while the fragments are gathered to a spot where they can be aspirated, and the ready recognition and removal of any obstruction which delays the process of aspiration. It will be no longer essential to pulverize the stone, but only to comminute it; and if, in so doing, the lithotrite can be kept free from impaction, the process will be more rapid and efficient.

During the last year I removed by lithotomy two soft stones, weighing 1272 and 1230 grains, from two male adults aged 40 and 24 years respectively, who recovered after various risks. I now cannot but think, that, with a tolerably sound bladder, a urethra of good size, a large lithotrite, and a large tube, the operation could have been performed with less risk by lithotrity.

We get a useful view of the interior of the bladder by examining it in position, through an opening in its summit. This part of the organ, and the free and thin posterior wall, are mainly concerned in distension. The floor of the bladder is comparatively firm and flat, and, if the subject be in good condition, adheres to a thick mass of cellular tissue in and near the ischio-rectal fossæ, upon which it rests. This mass is traversed by the rectum variously distended; and this canal, in a thin subject, may be advantageously filled with air during an operation, to facilitate its indentation by an instrument; reversing, for the operation of lithotrity, one of the precepts of lithotomy.

The sigmoid flexure is largely concerned in compressing the bladder behind. The posterior wall of this viscus may be so crowded by the intestines that it becomes flat or even concave. A horizontal section of the bladder is then transversely oval, flattened between the intestines behind and the pubes in front, each of these indenting it. A well-filled or tense abdomen tends so to shorten the antero-posterior diameter of the bladder, that, while a large stone may gravitate backward into that part of the bladder which is compressed by the intestines, carrying the thin wall with it, it is not so with a small fragment, which, unless the floor be artificially depressed, may lie on one side or the other of the vesical orifice more readily than at a considerable distance behind it. So in sounding with a curved sound, it may sometimes be a little difficult to move the instrument back and forth in the urethra, when its extremity may be readily turned down upon the floor of the bladder on either side. It is seen also (see Figs. 7 to 11), as a result of this conformation, that a lithotrite or straight

Figs. 7 to 11. Plaster casts of bladders variously distended, and holding instruments, to show the effect of a slight pressure in indenting the floor of the bladder, in order to facilitate the approach of fragments. The dotted line near the summit of each represents the level of an air cavity, which makes it possible to place the cast in the exact position it occupied in the horizontal subject.

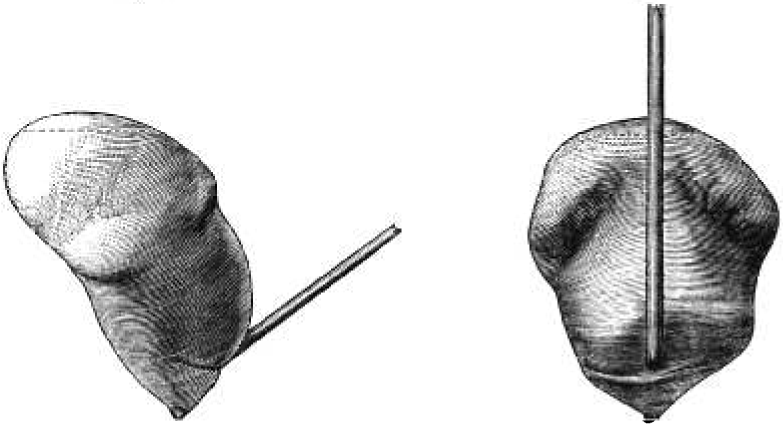


Fig. 7. Fig. 7a.

Figs. 7 and 7*a*. Side and front view of a distended bladder of singular symmetry. The original suggests the torso of a Silenus; the pectoral pouches overhanging the pubes; the abdomen beneath the symphysis; while the hollow loins were cushioned on the sigmoid flexure which indented them. The extremity of a curved tube is seen below, at the apex of an inverted tunnel: and just above it, a trace of the vesical valve.

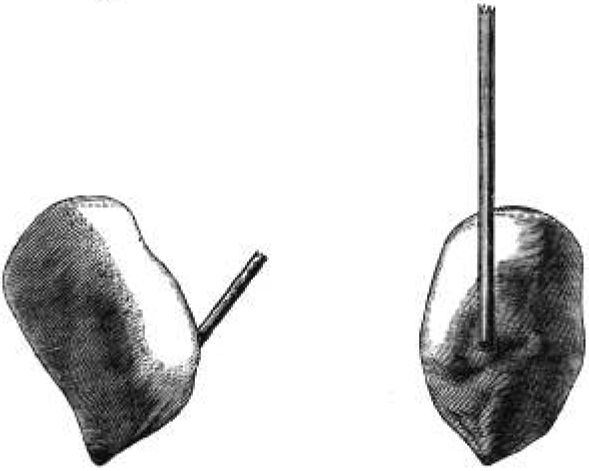


Fig. 8. Fig. 8*a*.

Figs. 8 and 8*a*. A less distended bladder, containing a straight tube which indents the posterior wall.

Fig. 9.

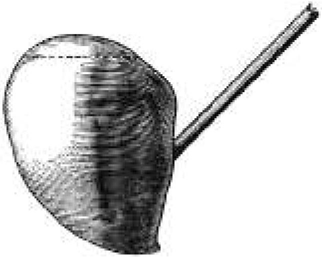
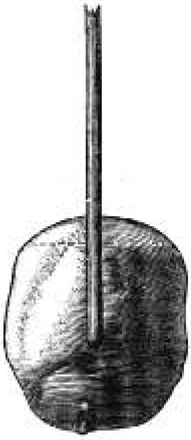


Fig. 9*a*.



Figs. 9 and 9*a*. A bladder with a curved tube brought forward so as to indent the floor behind the prostate.

Fig. 10.

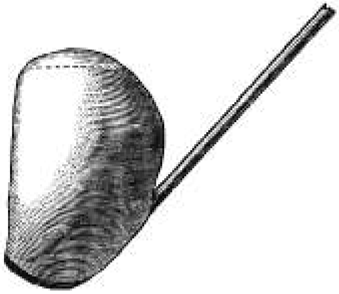
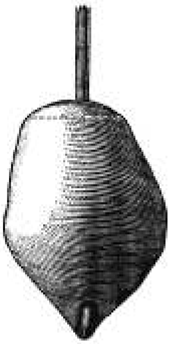


Fig. 10*a*.



Figs. 10 and 10*a*. A bladder containing a large lithotrite, which has so depressed and extended the floor that the posterior wall rises perpendicularly.

Fig. 11.

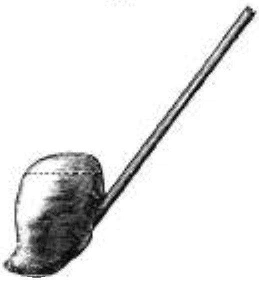
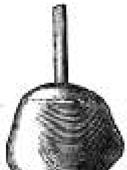


Fig. 11*a*.



Figs. 11 and 11*a*. A bladder with a very small injection, imprisoning a lithotrite.

tube, standing at an angle of 45° with the recumbent body, abruptly buries its extremity in the floor of the bladder near the foot of the posterior wall, which then becomes more upright, and does not lie upon the centre of an extended concave surface, as it is sometimes represented. The deep pit at the extremity of the straight tube, and the similar depression made further forward by the curved and inverted tube (see Fig. 9), show how readily fragments can be made to gravitate to the tube orifice, provided the latter be not plugged by the mucous membrane. The curved tube, when inverted, rests on the adherent floor; but the straight tube, bearing upon the free and thin posterior wall (Fig. 8), should not be urged too forcibly against it. In either case, the nearer the instrument approaches a vertical position, the deeper will be the indentation. A pit of this sort, formed in the elastic floor by an almost insensible pressure of the instrument, explains the observation of Thompson, that, when a fragment is caught by the lithotrite,, many more are likely to be caught, like fish, in the same spot. A central indentation of the floor also explains how, in certain cases of large stone, a lithotrite may be passed back and forth beneath it without touching it, unless the beak is tilted up. The stone may then seem to adhere to the upper wall of the bladder, and to be suspended from it.

CASE I.—Dec. 14, 1875. Age, 64. Date of symptoms, six years. Two or three stones, measuring from half an inch to more than three-quarters. Three sittings. First sitting: No fragments were removed through a tube. Second sitting: Interval, seven days; duration, forty-five minutes, under ether; quantity removed, "a large mass of fragments;" size of tube, twenty-seven. Third sitting: Interval, twelve days; quantity removed, "a few fragments." Result: The patient was discharged well, one week after.

CASE II.—May 15, 1876. Age, 60. Date of symptoms, twenty years. Two stones, of one and one-half inches and three-quarters of an inch diameter, respectively. One sitting: duration, one hour and a half, under ether; lithotrite introduced three times; quantity removed, one hundred and sixty-seven grains; size of tube, twenty-nine; there was afterwards a slight cystitis; no fragments were passed; in two weeks the patient was again sounded, and no fragments were found. Result: Discharged well.

CASE III.—Aug. 6, 1876. Age, 62. Date of symptoms, eighteen months. Several stones, none larger than three-quarters of an inch. The patient was confined to the house, in great pain, drawing his water every half hour or less. The prostate was unusually large. One sitting: duration, about one hour and three-quarters, under ether; size of tube, twenty-nine. He afterwards passed a few grains of sand only. Result: No unfavourable symptoms; almost entire relief from pain. Later, no difficulty in retaining water, but continues to pass catheter; gained flesh and former health, and resumed avocation.

CASE IV.—Dec. 14, 1876. Age, 66. Date of symptoms, two years. Single stone. One sitting: duration, about an hour, under ether; quantity removed, one hundred and eleven grains; size of tube, twenty-eight. Result: The patient did well for two days; then there was a chill, with higher temperature; pain in the back, and pain referred to the left hip; a gradually failing pulse; moderate meteorism, with but little tenderness; death on the sixth day. An autopsy was not permitted.

Case V.—Jan. 8, 1877. Age, 55. Date of symptoms, one year. Single stone. A severe chill followed the primary examination. Seven days after, the meatus was incised and enlarged from 28 to 31 Charrière. Diameters of stone, ten to twenty millimetres. One sitting: duration, one hour, under ether; size of tube, thirty-one. Result: No sand nor fragments were afterwards passed; nor were there any subsequent symptoms.

Case VI.—April 21, 1877. Age, 43. Single stone. Necrosis. Five years ago the pelvis of this patient was crushed. Sinuses, discharging dead bone, opened on both hips. Six months after the injury, symptoms of stone existed. One sitting: duration, one hour and a half, under ether; meatus incised; size of tube, thirty; quantity removed, sixty-six grains, and also three small pieces of bone, doubtless nuclei, one of which was incrusted. An indurated spot was detected by the tube, where the bladder seemed to adhere to the pelvis. Four days after, under ether, the lithotrite brought away with difficulty, through the urethra, a square scale of bone, too elastic to be broken, measuring five-eighths of an inch by seven-sixteenths, but neither sand nor fragments. Result: There were no unpleasant symptoms at any time; and, after another careful examination for bone, the patient was discharged well.

Case VII.—(Dr. T. B. Curtis's case) March 6, 1877. Age, 54. Date of symptoms, two years. Single stone. One sitting: diameter of stone, one inch and a quarter; duration, one hour and twenty-five minutes, under ether; lithotrite introduced three times; size of tube, thirty-one; quantity removed, when dry, two hundred and fifty-seven grains; the six largest fragments weighed together twenty-four grains; the strained urine yielded during the next week two and one-half grains. Result: Rapid recovery, with no subsequent symptoms.

Case VIII.—(Dr. C. B. Porter's case) Aug. 19, 1877. Age, 61. A large, flabby man, with a feeble pulse. Date of symptoms, twenty-six years. Two stones, one of which is so large that it is barely possible to lock the lithotrite. Passes water every fifteen or twenty minutes. Three sittings. First sitting: Duration, one hour and a half, under ether: size of tube, twenty-eight; quantity removed, two hundred and twenty-eight grains; passed afterwards one hundred and eight grains. Second sitting: Interval, four days; duration, three hours, under ether; size of tube, thirty; quantity removed, seven hundred and forty-four grains; passed afterwards sixteen grains. No after symptoms of importance. Third sitting: Interval, five days; duration, three and three-quarters hours, under ether; size of tube, thirty-one; quantity removed, seven hundred and six grains; no pain nor discomfort afterwards; total number of grains after drying, one thousand eight hundred and two. Result: Discharged well, two weeks from the date of the first operation. After a few weeks the patient could retain his water from three to four hours.

Remarks—The details of the earlier of these operations are expressed with less exactness than I might now desire, but were dictated by myself at the time, and are within the fact, as to the duration of each operation, and the size of the stones. These cases, all of soft stones (*i. e.*, not oxalate of lime), are the only ones by which the method which is the subject of this paper has been tested. As statistics, they are not so numerous as to have importance. The fatal case, without an autopsy, a circumstance I greatly regretted, must pass for what it is worth. The other cases abundantly illustrate what this operation is able to accomplish in removing at once a large quantity of stone by the urethra, and demonstrate a tolerance by the bladder of protracted manipulation which has not hitherto been recognized.

ARTICLE XI.

CASE OF DISLOCATION OF THE HIP UPWARDS AND FORWARDS ON THE PUBES, OF TWENTY-SIX DAYS' STANDING, SUCCESSFULLY REDUCED: FOLLOWED BY COMPLETE RECOVERY.

By M. H. HENRY, M.A., M.D., Surgeon-in-Chief of the State Emigrant Hospitals, Ward's Island, New York, etc. etc.

CASE.—Joseph P., Alsatian, aged 19, height six feet two and a half inches, well developed and muscular, admitted in the surgical division of the State Emigrant Hospital on the evening of the 17th of October, 1873. He furnishes the following history of his injury: On the 3d inst. he fell from a tree—a distance of eighteen or twenty feet—to the ground, striking, as he believes, first on his feet, then tumbling across a log, receiving a severe blow on or near the trochanter of the left side. He was taken home on a stretcher, but did not remain in bed beyond the second day. Being unable to perform any labour, he entered the hospital. He could, at this time, walk without much difficulty. From the description of his injury, which he gave on entering the hospital, it was thought by the house-surgeon to be little more than a severe contusion, and a careful examination was not made until several days after his entrance, when a dislocation of the head of the femur on the pubes was discovered.

The limb was shortened, but not to any great extent—scarcely an inch; slightly flexed, abducted, and everted. The head of the femur could be plainly seen, as well as felt, resting on the margin of the horizontal ramus of the pubes, on the outer side of the femoral vessels. There was some depression along the outer aspect of the thigh, and additional prominence over and in the region of the gluteal muscles. There was decided immobility of the limb—flexion being exceedingly limited and difficult.

Oct. 23d. The patient was placed under the influence of ether, and assisted by my friend, Dr. Thomas T. Sabine, and the resident staff of the hospital, I attempted reduction. The limb was very rigid, and the efforts at flexion, adduction, abduction, or circumduction, for a time met with very limited success. By continuing the movements, together with extension, the false adhesions, which were very complete and strong, were finally broken up. The mobility of the joint was somewhat increased, but, as the patient had then been under the influence of ether for some time, the rigidity of the surrounding parts being still very great, and from fear of exciting severe inflammation by further efforts at this time, it was deemed